

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
)	
Ligado Networks LLC)	IBFS File Nos. SES-MOD-20151231-00981; SAT-MOD-20151231-00090;
)	SAT-MOD-20151231-00091; SAT-
Modification Applications and Amendment)	AMD-20180531-00044; SAT-AMD-
To Modification Applications)	20180531-00045
)	
)	
LightSquared Technical Working Group)	IB Docket No. 11-109
Report)	

COMMENTS OF DEERE & COMPANY

Deere & Company (“Deere”) hereby submits these brief comments in response to Ligado Networks LLC’s (“Ligado’s”) amended application for modification of its Mobile Satellite Service (“MSS”) licenses.¹ Deere neither opposes nor affirmatively endorses the amended Modification Application. Deere offers these comments (1) to reaffirm its strong conviction that the appropriate metric for determining the potential for harmful interference to GNSS devices and applications is whether there is a one (1) dB decrease in Carrier-to-Noise Power Density (“C/N₀”) ratio, and (2) to clarify the record with respect to Deere’s position on the potential for interference from the proposed system -- even as amended -- to GPS devices other than Deere’s future devices.

¹ Letter to Marlene H. Dortch, Secretary, FCC, from Gerard J. Waldron, Counsel to Ligado Networks LLC (“Cover Letter”) and accompanying Amendment to License Modification Applications attachment (“Application Amendment”) (filed May 31, 2018); *See also* Satellite Policy Branch Public Notice, Space Station Applications Accepted for Filing, Report No. SAT-01321 (rel. June 8, 2018).

At the outset, Deere reiterates that it is a strong supporter of expanded broadband services and has actively advocated for greater broadband deployment particularly in rural areas to help meet the growing bandwidth demands of high precision farming that make up modern agricultural operations.² As Deere has consistently stated, Deere’s primary interest in Ligado’s network proposals -- and in its predecessor’s proposal -- is to ensure that the deployment of a terrestrial network in what was historically satellite spectrum will not cause interference to the adjacent U.S. GPS and other international Global Navigation Service Systems (“GNSS”) which are essential to “smart farming” and to today’s agricultural equipment which incorporates state-of-the-art precision guidance systems and technology designed for intense data gathering and processing.³ These high-precision agricultural systems require both interference-free precision navigation systems and adequate rural broadband and wireless coverage to meet demand for greater efficiency and enhanced performance. Given the critical importance of interference-free GPS and GNSS to the agricultural sector, as well as to many other sectors, it is essential that the Commission and

² See Comments of Deere & Company, *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans In a Reasonable and Timely Fashion et al.*, GN Docket No. 15-191 (filed Sept. 15, 2015); Comments of Deere & Company, *Connect America Fund; A National Broadband Plan for Our Future; ETC Annual Reports and Certifications; Establishing Just and Reasonable Rates for Local Exchange Carriers; Universal Service Reform – Mobility Fund; Developing a Unified Intercarrier Compensation Regime*, WC Docket Nos. 10-90, 07-135, 14-58; WT Docket No. 10-208; CC Docket No. 01-92 (filed Aug. 8, 2014); Reply Comments of Deere & Company, WC Docket Nos. 10-90, 07-135, 14-58; WT Docket No. 10-208; CC Docket No. 01-92 (filed Sept. 8, 2014); Comments of Deere & Company, *Broadband Opportunity Council Notice and Request for Comment*, Rural Utility Service, U.S. Department of Agriculture, and the National Telecommunications and Information Administration Docket No. 1540414365-5465-01, RIN 0660-XC019 (filed June 10, 2015).

³ GPS-enabled precision steering systems, modems, sensors, third-party and cloud applications, and powerful in-cab and farmhouse analytic and mapping programs comprise the highly specialized systems that are expected to enable today’s farmers to meet the rising global demand for food in an increasingly challenging economic environment. See, e.g., John F. Reid, *The Impact of Mechanization on Agriculture*, 41 THE BRIDGE, Fall 2011, at 14. (“A modern, high-end agricultural machine system is effectively a mobile, geospatial data-collection platform with the capacity to receive, use, sense, store, and transmit data as an integral part of its operational performance.”) See also Jonathan Gitlin, *Self-driving Factors and Data Science: We Visit a Modern Farm*, ARSTECHNICA (June 18, 2016, 12:00 PM EDT), <http://arstechnica.com/cars/2016/06/self-driving-tractors-and-data-science-ars-visits-a-modern-farm/>

policymakers at other agencies have a comprehensive understanding of, and the technical records reflect analysis of, the risk of serious interference that higher power terrestrial services in nearby spectrum pose to many classes of GPS receivers and important GPS end users.

I. A ONE (1) dB DECREASE IN CARRIER-TO-NOISE DENSITY REMAINS THE ONLY EMPIRICAL, UNIVERSAL AND QUANTIFIABLE METRIC FOR CONFIRMING HARMFUL INTERFERENCE TO GPS/GNSS SERVICE

In its amendment, Ligado seeks to further revise its proposal to deploy a terrestrial network using its MSS radiofrequency spectrum by reducing power of its ATC base stations operating in the 1526-1536 MHz (“Lower Downlink Band”) band, limiting the proximity of Ligado ATC base station antenna in the Lower Downlink Band to specified FAA obstacle clearance surfaces, and complying with certain monitoring and reporting requirements.⁴ Deere confirms that because the proposal, as amended, remains consistent with the technical and licensing parameters set forth in Deere’s 2015 litigation Settlement Agreement,⁵ Deere does not oppose grant of Ligado’s proposed Amended Modification Applications.⁶

Deere nonetheless advises that its position with respect to Ligado’s Amended Modification Applications must not be interpreted as acquiescence in or, in any way agreement with, Ligado’s continued efforts to depart from long-accepted practice and establish a new metric for determining

⁴ See Applications of LightSquared Subsidiary LLC, Narrative, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, and SES-MOD-20151231-00981 (“Modification Applications”) and Application Amendment (collectively, “Amended Modification Applications”).

⁵ The Deere Settlement Agreement sets forth technical parameters and licensing conditions, including, among other terms, specified power limits, out-of-band emissions (“OOBE”) limits, and the determination that the 1545-1555 MHz band may not be used for terrestrial operations. The Settlement Agreement and Mutual Release is on file with the Commission. See New LightSquared LLC Written Ex Parte Presentation, IB Docket Nos. 12-340, 11-109; IBFS File Nos. SAT-MOD-20101118-00239, SAT-MOD-20120928-00160, SAT-MOD-20120928-00161, SES-MOD-20121001-00872, SES-RWL-20110908-01047, SES-MOD-20141030-00835 (filed Dec. 8, 2015).

⁶ Deere’s position is also contingent on the condition that any reissued license will also expressly provide that the protective technical parameters that Ligado has agreed to in the context of its agreement with Deere will apply as a continuing condition to any assignee or transferee of Ligado’s L-band licenses.

potential harm to GPS and other GNSS systems based on Key Performance Indicators (“KPIs”). Deere does not agree with this approach and reaffirms its staunch support for application of a one (1) dB decrease in Carrier-to-Noise Power Density (“C/N₀”) (the “1 dB Standard”) as the appropriate metric for determining whether a GPS receiver has experienced harmful interference. Deere has previously voiced support for this metric, explaining that there is an undeniable correlation between a 1 dB decrease in C/N₀ and harmful interference, including with respect to high-precision receivers.⁷ The Commission and other agencies have relied on the standard for many years. Prominent GPS device manufacturers and end users have expressed on the record their unified and unwavering support for the 1 dB Standard.⁸

Ligado nonetheless continues to contest the use of the 1 dB Standard arguing, without support, that the Commission should depart from the long-established and widely accepted standard for determining the potential for harmful interference to GNSS devices and applications. For example, Ligado claims in its amendment that the Department of Transportation’s (“DOT’s”) certified aviation analysis is

”free of a fundamental error that fatally undermines the DOT Report’s assessment of all other GPS devices: its empirically unsupported treatment of a 1 dB increase in a GPS device’s idiosyncratic and self-reported carrier-to-noise-density ratio (C/No) as a proxy for defining when the device has experienced ‘harmful interference’.”⁹

No empirical, universal and quantifiable alternative to the 1 dB Standard exists for evaluating harmful interference into a GPS/GNSS service. In particular, the Commission should avoid the

⁷ See Reply Comments of Deere & Company at 7-12, IB Docket Nos. 12-340, 11-109, IBFS File Nos. SAT-MOD 201120928-00160; SAT-MOD-20120921-00161; SAT-MOD-20101118-00239; SES-MOD-20121001-00872 (filed June 21, 2016) (“Deere June 2016 Reply Comments”); Reply Comments of Deere & Company at 8, IB Docket No. 11-109, IBFS File No. SAT-MOD-20101118-00239 (filed Aug. 15, 2011).

⁸ See Deere June 2016 Reply Comments at 9.

⁹ Application Amendment at 3, fn. 9.

obvious pitfalls and shortcomings of attempting to evaluate interference into GPS/GNSS services based on end user outputs or metrics (*e.g.*, location accuracy), which are inherently subjective and unreliable in this context. Ligado relies on the Roberson and Associates (“RAA”) testing and the National Advanced Spectrum and Communications Test Network (“NASTCN”) report to assess potential interference to GPS devices, but both analyses are deeply flawed because they rely on a review of KPIs in an attempt to evaluate interference. Reliance on KPIs fails to fully account for the four principal attributes of GPS/GNSS -- accuracy, integrity, continuity and availability -- and do not account for the wide diversity of GPS receivers and use cases. Given the tremendous diversity in GPS/GNSS receiver design and use models, even the broadest, most inclusive test program cannot credibly claim to have harmonized and evaluated end user outputs in a meaningful way against a potentially interfering signal.

For example, with respect to location accuracy, a degradation of only a few centimeters may render a high-precision receiver unusable or inoperable, whereas a markedly greater degradation may not impact the end user of a general navigation and location device. Even within a discrete class or sub-class of device (*e.g.*, high-precision receivers) there may be varied expectations for location accuracy depending on the end user’s application. Moreover, location accuracy for some devices may involve only horizontal position, while other devices may place an emphasis on high accuracy in degraded reception scenarios. Employment of differential correction systems to augment the GNSS signals further complicates the use of position accuracy as a degradation metric.

Due to this diversity in design and use models, any attempt to evaluate location accuracy would need to examine a virtually inexhaustible number of test scenarios to determine if harmful interference occurred from a proposed new terrestrial service, where location accuracy is only one

of several important end user outputs. As mentioned, integrity, continuity and availability are also critical and must be evaluated, and the criticality level of these attributes varies widely depending on the class of device and end user application.

It would be impractical and likely impossible to craft a universal, quantifiable and scientifically sound interference threshold around end user outputs that vary widely not just between classes of GPS/GNSS receiver, but in many instances between individual devices themselves within a class or sub-class. As such, the KPI approach that Ligado advocates is highly unreliable and falls far short as an adequate replacement for the long-standing, widely accepted 1 dB Standard. Any effort to evaluate harmful interference into GPS/GNSS service based on end user outputs is unlikely to survive rigorous scientific scrutiny. In contrast, the record is replete with scientific and real-world experience in support of continued use of the 1 dB Standard.¹⁰ In sum, the KPI approach is unreliable and otherwise flawed and should be rejected.

II. DEERE'S POSITION ON LIGADO'S AMENDED MODIFICATION APPLICATIONS

Deere further cautions the Commission that it must closely tie its assessment of the impact of the Deere Settlement Agreement to the specific terms of the agreement and refrain from

¹⁰ See, e.g., Letter from M. Anne Swanson to Marlene H. Dortch, Secretary FCC, Garmin International Written Ex Parte, IB Docket Nos. 11-109, 12-340; SAT-MOD-20120928-00161; SAT-MOD-20101118-00239; SES-MOD-20121001-00872 (filed May 16, 2018); Letter from Timothy St. J. Ellam, Counsel to NovAtel Inc. to Marlene H. Dortch, Secretary FCC, Written Ex Parte Presentation at 2, IB Docket Nos. 11-109, 12-340; SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981 (filed May 19, 2016); See also Letter from AGCO Corporation to Federal Communications Commission, IB Docket Nos. 11-109, 12-340 (filed June 6, 2016); Letter from Leica Geosystems, Inc. to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340; SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981 (filed May 27, 2016); Letter from Grayson Omans, CEO Phoenix Aerial Systems, Inc., IB Docket Nos. 11-109, 12-340 (filed May 26, 2016); Letter from Stephen M. Browne, Director and Executive Vice President, Veripos (US) Inc. to Federal Communications Commission, IB Docket Nos. 11-109, 12-340 (filed June 2, 2016); Reply Comments of Trimble Navigation Limited, IB Docket Nos. 11-109, 12-340; SAT-MOD-20120928-00160; SAT-MOD-20120928-00161; SAT-MOD-20101118-00239; SES-MOD-20121001-00872 (filed June 21, 2016) (disagreeing with use of KPIs to determine harmful interference).

adopting a broader interpretation of the scope of the agreement. In particular, Ligado argues in its amendment that:

The other evidence in the record, including the test results from the National Advanced Spectrum and Communications Test Network study and from the Roberson and Associates testing *as well as the co-existence agreements with the GPS device manufacturers, establish that other GPS devices can coexist with Ligado's proposed operations.*¹¹

The letter from Ligado's counsel as well as the attached Amendment to License Modification further claims that:

*Ligado's co-existence agreements with major GPS manufacturers and thousands of hours of empirical testing assure protection for all other classes of GPS devices.*¹²

These unqualified statements imply that Deere's Settlement Agreement stands as evidence that as long as Ligado's plan complies with the technical parameters outlined in the Settlement Agreement that *all* classes of GPS devices will be protected from interference. This interpretation is not supported. The terms of the Deere Settlement Agreement pertain only to the specific circumstances addressed by two individual parties and should not be misconstrued to apply generally to all GPS devices. Deere has been clear that its Settlement Agreement should not be viewed as corroborating Ligado's representation that its modified proposals resolve *all* GPS interference for all devices in all applications.¹³ Neither the terms of the Deere Settlement Agreement nor any Deere submission provides information on whether and to what extent Ligado's current proposal threatens harmful interference to the broad array of existing and future GPS-enabled devices and applications, other than to Deere's equipment.

¹¹ Application Amendment at 2.

¹² Cover Letter at 2-3; Application Amendment at 5.

¹³ See Deere June 2016 Reply Comments, at 5-6.

Further, with respect to interference to *Deere's* GPS-enabled equipment, the Deere Settlement Agreement does not assure that all Deere receivers can coexist with Ligado's network. The Deere Settlement Agreement reflects Deere's judgment only that, *notwithstanding interference to existing Deere receivers*, Deere will be able to address interference issues in its technology plan for future Deere receivers assuming the Ligado network complies with the technical and other terms set forth in the Deere Settlement Agreement.

In short, the Deere litigation Settlement Agreement should not be interpreted as proof that any device beyond Deere's future devices can coexist under the modified network. Deere looks forward to working with the Commission and other stakeholders on these important public interest issues.

Respectfully submitted

/s/ Catherine Wang

Catherine Wang

Morgan, Lewis & Bockius LLP

1111 Pennsylvania Avenue, N.W.

Washington, DC 20004-2541

Tel. (202) 739-3000

Fax (202) 739-3001

Attorneys for Deere & Company

Steve Wilson
Director, Advanced Engineering

Mark Rentz
Senior Systems Engineer

Mark Lewellen
Spectrum Policy Manager

Deere & Company
One John Deere Place
Moline, IL 61265

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